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[Article by V. M. Abalakina, O. K. Kleymenova, Yu. M. Dedkov; State Scientific-Research, Design, and Development Institute of Alloys and Non-Ferrous Metals Processing, Moscow; UDC 546.59:542.61:543.432]

[Abstract] A highly sensitive, simple, and metrologically reliable extractive photometric method was developed for determining the presence of 0.001 to 1 percent gold in secondary alloys containing Sn, Pb, Sb, Cu, Cd, Bi, and Ag. First, the tin and arsenic are distilled in the form of bromides, and the lead is precipitated as lead chloride. Chloroform is used to extract $AuCl^-_4$ from solution (e.g., 0.5 M of H_2SO_4 and 0.25 g-ions/cu dm of Cl^-) in the presence of dimethylformamide (DMFA), and methylene blue is used for complexing the extract in its organic phase. A graph constructed on the basis of a pure gold solution is used to plot the gold concentrations. This graph is linear within a gold concentration interval of 0.4 to 2.8 μg/cu cm. Due to the difficulty in reproducing the control test, the optical density of the complex extracts is measured relative to that of the chloroform. The optimal extraction conditions are: 0.25 to 3.0 M of H_2SO_4, 0.06 to 2.5 g-ions/cu dm of Cl^-, 13-26 percent by volume DMFA; a 1:1 ratio of aqueous to organic phases; extraction duration—5-10 s. The $AuCl^-_4$-MB complex is stable in extract form for more than three days, and its maximum light absorption is found at 650 nm. The quantitative results from using this method to determine the presence of gold in secondary tin-lead solders were presented. Tables 1; references 6: Russian.

Kinetic Determination of the Presence of Osmium, Ruthenium, Iridium, and Rhodium From a Single Weighed Quantity of Copper Alloy

937D0085B Moscow ZAVODSKAYA LABORATORIYA in Russian Vol 58 No 10, Oct 92 pp 3-4

[Article by Ye. G. Khomutova, L. Ye. Romanovskaya, L. P. Zhitenko, and A. P. Rysev; Moscow Institute of Fine Chemical Technology imeni M. V. Lomonosov; UDC 546.92:543.5]

[Abstract] Kinetic methods were developed for determining the presence of osmium, ruthenium, iridium, and rhodium in a single weighed quantity of copper alloy. A sample weighing from 1 to 1.5 g is fused at 750° with sodium hydroxide. To avoid the formation of copper hydroxide sediment, the molten metal is leached in an ammonia solution. The solution is diluted with up to 100 ml of water until the final ammonia concentration does not exceed 6 m/l. Three aliquots are taken from this solution for subsequent analysis. To determine the presence of osmium, a 10- to 20-ml aliquot is diluted in a distillation flask with 100 to 150 ml of water; 40 ml of concentrated sulfuric acid is then carefully added to this solution. Osmium tetroxide is distilled in 0.1 M of acetic acid. The presence of osmium in the distillate is determined from the oxidation of sodium arsenite with potassium iodate. The presence of iridium is determined in a similar manner, except that its presence is determined from the oxidation of mercuric nitrate by cerium sulfate in the presence of perchloric acid. The portion of ruthenium that gets into the distillate does not interfere with the analysis. Ruthenium is tested for in a similar way, except that the aliquot is boiled with hydrochloric acid for 20 to 30 minutes, and ruthenium presence is determined from the oxidation of tropeolin OO with potassium periodate. The presence of the other three metals does not interfere with the process of testing for ruthenium. To test for the presence of rhodium, the last remaining aliquot is boiled with nitric acid in the presence of sodium periodate to extract the ruthenium and convert the rhodium. The solution pH is brought to 1-2, and the solution allowed to stand for 30 minutes, after which the presence of rhodium is determined from the oxidation of methylene orange by the sodium periodate. Tables 2, references 6: Russian.

An Extractive Spectrophotometric Method of Determining the Presence of Microquantities of Arsenic in Pure Palladium

937D0085C Moscow ZAVODSKAYA LABORATORIYA in Russian Vol 58 No 10, Oct 92 pp 4-5

[Article by L. I. Potapenko and T. A. Babkina, Siberian State Design and Scientific-Research Institute of Non-Ferrous Metallurgy, Krasnoyarsk; UDC 546.98:542.61: 543.42.062]

[Abstract] An extractive spectrophotometric method was developed for determining the presence of microquantities of arsenic in 99.98 to 99.8 percent pure palladium. The method involves dissolving a 1-g specimen of palladium in 25-30 cu cm of sulfuric acid and heating the solution for 15 to 17 minutes after sulfuric acid vapors begin appearing. The solution is cooled and continuously agitated as it is transferred to a graduated column containing 30 to 40 cu cm of water. The column is filled with more water until it reaches its capacity of 100 cu cm, after which the solution is mixed and filtered into a dry beaker. A 2- to 10-cu cm aliquot of the solution is put into a column with a 100 cu cm capacity, and 5 cu cm of sulfuric acid and 15 cu cm of hydrochloric acid are added. After the solution cools, 1 cu cm of a 25 percent solution of stannous chloride prepared in hydrochloric acid is added, then 2 cu cm of a 10- percent solution of sodium nitrite. The sample solution is allowed to stand for 3 minutes, and then 1 cu cm of a saturated urea solution is added. The solution is transferred to a 250-cu cm separatory funnel that is filled with 50-60 cu cm of water, 15 drops of a 0.5 percent solution of Brilliant Green, 10 cu cm of toluene, and vigorously shaken for 2 minutes. After settling for half a minute, the water layer is poured off and the toluene layer filtered through cotton wadding into a dry test tube. After 15-20 minutes,

the optical density of the solution is measured on an SF-46 spectrophotometer at 640 nm in a photoconductive cell with an absorbing layer thickness of 10 mm. Arsenic concentration is found from a graph constructed within an arsenic concentration interval of 0.5 to 6 μg. The results of using this method to test for the presence of arsenic in pure palladium were presented and compared with those from other physical methods of analysis. Tables 2; references 7: Russian.

Measuring Thermal Stresses in Heterophasic Ceramic Materials

937D0085D Moscow ZAVODSKAYA LABORATORIYA in Russian Vol 58 No 10, Oct 92 pp 30-32

[Article by O. N. Grigoryev and G. S. Krivoshey; Institute of Problems in Materials Science of the Ukrainian Academy of Sciences, Kiev; UDC 539.26:666.7]

[Abstract] The X-ray $\sin^2\psi$ method was used to measure thermal stresses in an Si-SiC ceramic system. The ceramic was made by reaction sintering, during which a silicon carbide matrix was impregnated with liquid silicon. The ceramic structure was made up of α- and β-SiC grains 1 to 10 μm in diameter (some as large as 20 μm in diameter) and silicon grains about 10 μm in diameter. Because of the difficulties inherent in the application of this particular X-ray method for this purpose, thermal deformations were first measured in the silicon, after which the stresses were calculated for both the silicon and the silicon carbide, taking into account the equilibrium conditions in the latter. The findings were as expected. The main stresses in the silicon are compressive due to the stiff matrix of SiC grains. Nonhydrostatic compressive behavior of the material is caused by a layer with a one-dimensional stressed state near the surface. Increased stress levels near the surface might be a consequence of diamond grinding. These findings show that by analyzing the effects of elastic deformation in one phase of a heterophasic ceramic system, a sufficiently detailed analysis of its stressed state can be performed. The method can also be extended to non- cubical systems. Figures 4; references 7: 5 Russian, 2 Western.

Physical and Chemical Study of $Ge_3Bi_2Te_6$, $GeBi_2Te_4$, and $GeBi_4Te_7$ Laminar Semiconductor Compounds

937D0094C Moscow NEORGANICHESKIYE MATERIALY in Russian Vol 29 No 1, Jan 93 pp 50-53

[Article by L.Ye. Shelimova, O.G. Karpinskiy, M.A. Kretova, G.U. Lubman, Metallurgy Institute imeni A.A. Baykov at Russia's Academy of Sciences; UDC 546.24:541.123.7]

[Abstract] An attempt is made to determine the homogeneity boundaries of the $Ge_3Bi_2Te_6$ (A), $GeBi_2Te_4$ (B), and $GeBi_4Te_7$ (C) compounds and plot the isothermal cross section of the Ge-Bi-Te system at 773K. To this end, alloys whose composition falls along the cross sections of "ternary compound-system component" are examined by structural microanalysis and X-ray diffraction analysis as well as microhardness measurements. The alloys are prepared by ampoule synthesis by fusing the components at 1,073K with subsequent annealing at 773K for 1,000 h. The radiographic study is carried out in a DRON-3M diffractometer in Fe*K* radiation controlled by a PC/AT microcomputer. The isothermal cross section of the ternary system and a fragment of the isothermal cross section of the ternary system and the dependence of microhardness on the degree of deviation from stoichiometry for all three components are plotted. The boundaries of the homogeneity domain are outlined. An analysis of the interatomic spacing in the ternary compound structure shows that the distance between the atoms of Te belonging to adjacent packs is high compared to that within the packs. The homogeneity domains are shown to be oriented along the "compound-Ge" cross sections in the Ge-Bi-Te system. An abnormally high germanium solubility in compounds B and C is discovered. Figures 3; tables 2; references 9: 8 Russian, 1 Western.

Metal-Polymer Materials for Hydrogen Accumulation

937D0079G Moscow NEORGANICHESKIYE MATERIALY in Russian Vol 28 No 10-11, Oct-Nov 92 pp 2116-2119

[Article by S.V. Bogomolov, Yu.V. Levinskiy, S.S. Plotkin, Moscow Institute of Fine Chemical Engineering imeni M.V. Lomonosov; UDC 541.44:546.654'74+621.762.34:678]

[Abstract] The shortcomings of almost all known intermetallic compounds (IMS) used for storing hydrogen prompted a comprehensive study of the service and physical and chemical properties $LaNi_5$-polydiene composites (particularly cis-1,4-polyisoprene (PI)) intended for storing hydrogen and capable of long-tern operation without failure. Commercial $LaNi_5$ powder (TU 14-127-208-82) and an aqueous dispersion of polyisoprene (ICO-2005) are used as the source materials, and the composites are prepared by mixing the sorbent powder with water and dispersing the polymer (latex) and molding and drying the mixture. The sorbent particle distribution and the specific surface of the powder are measured and the microstructure is studied under a JSM-U3 (Japan) scanning electron microscope). The hydrogen adsorption and desorption kinetics are examine within a -30 to +300° C range at a 4.0 MPa pressure using hydrogen prepared by thermal decomposition of the $LaNi_5H_x$ hydride. The rate of hydrogen absorption by materials after 10 activation cycles and the behavior of the specific surface of the sorbent as a function of the number of hydrogen absorption-desorption cycles are plotted. Given constant temperature and initial pressure over the sample and an identical powder mass, the ratio of the degree of reaction approximation to equilibrium for a pure intermetallic compound and an intermetallic compound in a composite is equal to the ratio of their specific surfaces. It is recommended that a 10-60 percent aqueous dispersion of polymer in an amount ensuring its concentration in the ready product of 5-15 percent by mass (or 10-40 percent by volume) be used for making these materials. The materials are shown to have a long service life. Figures 3; references 13: 6 Russian, 7 Western.

$YBa_2Cu_4O_8$ and $Y_{0.9}Ca_{0.1}Ba_2Cu_4O_8$ Synthesis in Air

937D0079H Moscow NEORGANICHESKIYE MATERIALY in Russian Vol 28 No 10-11, Oct-Nov 92 pp 2124-2128

[Article by V.A. Krzhizhanovskaya, O.N. Yegorova, V.B. Glushkova, L.V. Sazonova, Ye.N. Solovyeva, A.V. Komarov, Silicate Chemistry Institute imeni I.V. Grebenshchikov at Russia's Academy of Sciences; UDC 541.124:546.641'56'431]

[Abstract] The high oxygen content stability of the $YBa_2Cu_4O_8$ (1-2-4) 80K high-T_c compound and its synthesis methods are discussed and an attempt to synthesize $YBa_2Cu_4O_8$ and $Y_{1-x}Ca_xBa_2Cu_4O_8$ in the air at a 730°C temperature with subsequent heat treatment is reported. To this end, the coprecipitation method which makes it possible to produce the reaction components in a finely disperse or amorphous state and a more active form is used. The sodium hydroxide solution in ethyl alcohol is used as the precipitating agent. The diffraction patterns of the precipitated samples after heat treatment in the air, the complex thermograms of YBaCuO and YCaBaCuO samples synthesized at a 730° C temperature, and the temperature dependence of resistivity of a 1-2-4 sample produced by sintering at 720° C are plotted. The synthesized compounds have a critical temperature of 81 and 85K, respectively. The study shows that up to a 760-780° C temperature, the mass of these compounds remains constant. The principal and unknown phases are identified and the lattice constants are determined. Figures 3; references: 13 Western.

Synthesis of $YBa_2Cu_3O_{7-x}$ High-T_c Superconductor Powders With Different Real Structures and Their Use for Preparing Thick Films

937D0079I Moscow NEORGANICHESKIYE MATERIALY in Russian Vol 28 No 10-11, Oct-Nov 92 pp 2129-2135

[Article by N.N. Oleynikiov, S.R. Li, P.Ye. Kazin, G.P. Muravyev, Moscow State University imeni M.V. Lomonosov; UDC 539.216.2]

[Abstract] The effect of a change in the thermodynamic and macrokinetic parameters of high-T_c superconductor (VTSP) synthesis on the structure of real HTSC powders is discussed and an attempt is made to identify the physical and chemical characteristics of the real HTSC powder structure with a $YBa_2Cu_3O_{7-x}$ composition which is thought to be optimal for producing thick films. To this end, HTSC ceramic powders are synthesized by the cryochemical method from a salt mixture with a Y:Ba:Cu=1:2:3 ratio by atomizing a nitrate solution in liquid nitrogen with subsequent removal of solvent by sublimating dehydration. The initial salt product was exposed to heat treatment at 110° C for 5 h and at 600° C for 2 h, after which the powder was synthesized at a 21 kPa pressure in the air and at 10 Pa in Ar at 850° C for 6 h. The specific magnetization of Y-Ba-Cu-O powders with a varying prehistory, the dependence of the powder magnetization on the applied field strength according to magnetic analysis data, the dependence of the physical line broadening on the mechanical processing duration established by a radiographic analysis, and the critical temperature values of thick films produced from Y-Ba-Cu-O powders are plotted. The findings show that during the grinding, the destruction of particles or their aggregates occurs mostly in the weakest areas of the powder system, and activation of individual particles is

due to an increase in the concentration of various types of spatial defects. These data attest that the actual structure of the powder used for making thick films is closely related to the values of the T_{c0} critical temperature. Figures 5; references 16: 10 Russian, 6 Western.

Characteristics of Microstructure Formation of Thick Films of $YBa_2Cu_3O_{7-x}$ High-T_c Superconductor

937D0079J Moscow NEORGANICHESKIYE MATERIALY in Russian Vol 28 No 10-11, Oct-Nov 92 pp 2136-2140

[Article by D.I. Grigorashev, S.R. Li, N.N. Oleynikov, Moscow State University imeni M.V. Lomonosov; UDC 539.216.2]

[Abstract] The link between the properties of such functional ceramic materials as ferrites, ferro- and piezoelectrics, etc., and the parameters of their microstructure and the effect of the microstructure of the $YBa_2Cu_3O_{7-x}$ HTSC ceramics on the formation characteristics of the finer structure level which, in turn, determines the level of structure-sensitive properties are discussed and it is noted that existing correlations between the macrostructre and properties are still rather qualitative in nature. The physical and chemical peculiarities of the microstructure development of thick Y-Ba-Co-O ceramic films are investigated, and attention is focused on deriving quantitative data on the microstructure under study. To this end, thick films are prepared by the mask printing method whereby a paste from an HTSC powder and organic binder was applied to a single crystal MgO substrate through a wire mesh (325 mesh). To examine the effect of various factors on the microstructure formation, the original powder was separated into fractions or ground in a ball mill; the nonsintered films were exposed to hydrostatic compaction after application to the substrate at a 200 MPa pressure without contact with the press medium; and experiments were conducted to sinter free films separated from the substrates in order to examine the substrate-film factor role. The effect of the thick film preparation conditions on the microstructure parameters is summarized and the dependence of the mean crystal grain size in the film on the sintering temperature and duration is plotted. An analysis shows that the presence of particle aggregates in the initial powder is responsible for the crystal grain growth and the particle sticking to the substrate is the principal factor hindering this process. The findings indicate that the use of a protective Ag sublayer combined with a relatively low oxygen temperature and partial pressure in the gaseous phase during sintering make it possible not only to avoid the film interaction with the substrate but also enhance the sintering process. Figures 3; tables 1; references 15: 7 Russian, 8 Western.

Effect of Cooling Rate on Structure and Properties of Thick Films of $YBa_2Cu_3O_{7-x}$

937D0079K Moscow NEORGANICHESKIYE MATERIALY in Russian Vol 28 No 10-11, Oct-Nov 92 pp 2141-2146

[Article by S.R. Li, N.N. Oleynikov, A.M. Gaskov, Moscow State University imeni M.V. Lomonosov; UDC 539.216.2]

[Abstract] The problem of chemical interaction between the substrate and $YBa_2Cu_3O_{7-x}$ high-T_c superconductor thick films and ways of overcoming it are discussed and the effect of the thick HTSC film cooling rate within a temperature range which corresponds to the tetragonal→orthorombic phase transition on the HTSC film structure and properties is investigated. To this end, the HTSC powder is prepared by the cryochemical method from the solution of nitrates; following the salt charge decomposition at 850° C for 0.5 h, it is ground in a planetary mill for 0.5 h in isopropyl alcohol. The films are produced by mask printing and dried at 150° C and heat treated at 950° C for 0.5 h in an oxygen atmosphere and cooled under various conditions in order to examine the effect of the tetra→ortho transition rate on the HTSC properties. The X-ray diffraction study is carried out in a STADIP diffractometer (by STOE, Germany) in Cu*K* radiation while the surface composition is examined by Auger electron spectroscopy (OES) in a JAMP-10 spectroscope (by Jeol, Japan). The dependence of the critical temperature on the hardening temperature, electron microscope surface pictures, and the dependence of the relative carbon Auger signal strength on the etching duration are plotted. The findings show that the dependence of the structure and properties on the cooling rate (within the phase transition range) is preserved for all samples even with 1-2 μm crystal grains while an increase in the cooling rate leads to the appearance of microcracks which enhance the degradation processes. The authors are grateful to G.P. Muravyev for help with the X-ray analysis and A.A. Petryanik for the electron microscope study. Figures 3; references 17: 10 Russian, 7 Western.

Characteristics of Superconductor B-Sr-Ca Cuprate Formation From Glass Ceramic Quenched Melts

937D0079L Moscow NEORGANICHESKIYE MATERIALY in Russian Vol 28 No 10-11, Oct-Nov 92 pp 2147-2152

[Article by O.Ye. Furmakova, S.Yu. Zinovyev, V.B. Glushkova, A.G. Bulgakov, S.Kh. Suleymanov, Silicate Chemistry Institute imeni I.V. Grebenshchikov at Russia's Academy of Sciences; UDC 541.124:546.87' 56'42'41]

[Abstract] The use of rapid quenching for preparing superconducting materials on the basis of the Bi-Sr-Ca-Cu-O compound, particularly flakes with a thickness of approximately 0.1 mm and bulk ingots with a

thickness of close to 3 mm, is discussed, and the phase formation during the annealing of bulk ingots and flakes under identical melting and heat treatment conditions is examined and compared. To this end, quenched melts with a Bi:Sr:Ca:Cu ratio of 2:2:0:1, 4:3:3:4, and 1:1:1:2 prepared in an Uran radiant heating unit are examined. The samples are studied by X-ray diffraction and thermal analyses, electron probe microanalysis, and optical and electron microscopy. The ingots and flakes were annealed in Naber furnaces within a 20-850° C range controllable in 1° C steps with subsequent air tempering. The diffraction patterns of fused flakes and ingots annealed at different temperatures, the dependence of the X-ray maxima intensity on the flake and ingot annealing temperature, and thermogravimetric and differential thermal curves of flakes and ingots are plotted; ingot microphotographs in various reflected rays and electrons are shown. The solidification temperatures are measured and the phase formation sequence during annealing as well as the microstructure and element distribution in the initial and annealed samples are established. It is shown that the superconductor formation processes are oxidative in nature and are largely determined by the univalent copper concentration in the samples. The authors are grateful to N.V. Plandyal for help with the electron probe microanalysis. Figures 4; references 8: 2 Russian, 6 Western.

Calculation of $Y(Ba_{0.8}Sr_{0.2})_2Cu_4O_8$ Formation Enthalpy

937D0079M Moscow NEORGANICHESKIYE MATERIALY in Russian Vol 28 No 10-11, Oct-Nov 92 pp 2238

[Article by L.A. Reznitskiy, Moscow State University imeni M.V. Lomonosov; UDC 536.63:541.11]

[Abstract] The possibility of increasing the critical temperature of high-temperature superconductors by increasing the chemical internal pressure with a partial substitution of Ba with Sr is discussed and an attempt to calculate the $\Delta D_f H$ of the $Y(Ba_{0.8}Sr_{0.2})_2Cu_4O_8$ high-temperature superconductor allowing for the change in the numbers of cations during the HTSC formation from individual oxides is reported. References 4: 3 Russian, 1 Western.

Porous Composite Material Calcium Hydroxylapatite-Corundum

937D0086A Moscow OGNEUPORY in Russian No 11-12, Nov-Dec 92 pp 12-14

[Article by A. V. Galakhov, S. V. Kutsev, V. Ya. Shevchenko, Interbranch Research Center for Engineering Ceramics, Russian Academy of Sciences, and V. M. Tsekhanovich, M. Yu. Sheynin, and P. A. Arsenyev, Moscow Power Engineering Institute; UDC 666.762.11-127]

[Abstract] Synthetic ceramic based on calcium hydroxylapatite is a promising material for orthopedic and dental prostheses. Composites of this material with different contents of aluminum oxide were investigated for their mechanical strength, sinterability, phase composition, and porous structure. Specimens containing 20, 40, 60 and 80 wt. percent Al_2O_3 were prepared with a thermoplastic binder and cast into rectangular bars 6X6X65 mm. The binder content in all cases was 50 percent, and after firing to remove the binder all specimens had identical porosity of 0.5. They were then sintered at 1150 and 1250° C for 4 hours.

In all the specimens there was found to be an increase in the total volume of pores (corresponding decrease in density) as the sintering temperature increased from 1150 to 1250° C. The lower the Al_2O_3 content, the higher the density (volume of pores dropped). Three-point bending strength tests showed that for all the specimens, strength was higher when sintered at 1250 than at 1150° C, and the highest strength was observed in the specimen with 60 wt. percent Al_2O_3. Although this maximum indicates a strengthening effect which depends on concentration, the strength characteristics of the material overall fall short of those of natural bone. Nevertheless, the recorded strengthening effect from Al_2O_3 gives grounds to expect that the strength of the porous composite material can be increased high enough for practical use by improving the process for making it.

Structure, Nonuniformity and Certain Properties of Al_2O_3—$ZrO_2(Y_2O_3)$ Ceramic Produced by Oriented Crystallization

937D0086B Moscow OGNEUPORY in Russian No 11-12, Nov-Dec 92 pp 15-18

[Article by M. D. Lyubalin, A. V. Sudarev, All-Union Research and Technological Institute of Power Machine Building, and V. A. Pismennyy, State Optics Institute; UDC 669.018.45.017:548.5]

[Abstract] The orientationally crystallized eutectic Al_2O_3—$ZrO_2(Y_2O_3)$ was investigated to determine correlations between melt compositions and characteristics of structures that result from their solidification, to establish regularities of redistribution of components during crystallization, and to measure certain mechanical properties of the ceramic. It was found that as melts of this ceramic solidify, there is a redistribution of main components which leads to nonuniformities appearing in the material. The way that yttrium oxide enters the ceramic has the most appreciable effect on its structure and properties. A low concentration of Y_2O_3 in the mixture leads to incomplete stabilization of ZrO_2 grains and to cracks in the material. At a Y_2O_3 concentration of more than 8 percent, new phases almost always occur, and $ZrO_2(Y_2O_3)$ grains with an yttrium oxide content of more than 10-12 percent match poorly with the sapphire matrix.

Work with a material of eutectic composition does not solve the problem of the ceramic's uniformity, because during the melting- solidification process there occurs redistribution of components in the liquid phase due to gravitation, the difference in elasticity of vapors of components, and the effect of crystallographic orientation of the matrix on the composition of the material being synthesized.

New-Generation Refractory Concretes. Grain Composition and Volume Characteristics

937D0086D Moscow OGNEUPORY in Russian No 11-12, Nov-Dec 92 pp 22-27

[Article by Yu. Ye. Pivinskiy, "Intersil" Firm; UDC 666.974.2]

[Abstract] Selection of optimal grain composition for new- generation refractory concretes (ceramoconcretes and low-cement refractory concretes) and its effect of density are discussed. Ideal and actual curves of grain distribution are compared and analyzed, and volume characteristics of the composition of ceramoconcretes and low-cement refractory concretes are compared. The effect of the method of adding a finely dispersed binder on the properties of a silica-composition concrete is analyzed.

Self-Propagating High-Temperature Synthesis. Propagation and Structure of the Combustion Front

937D0086E Moscow OGNEUPORY in Russian No 11-12, Nov-Dec 92 pp 28-29

[Article by V. I. Sumin, Central Research Institute of Machine Building, and Yu. N. Makurin, Urals Polytechnical Institute; UDC 666.762.091]

[Abstract] The method of self-propagating high-temperature synthesis for making refractory materials is discussed. The key role that dispersity plays in the process is examined in its kinetic and thermodynamic aspects. Typical structure of the combustion wave with its temperature profile is presented, and features of propagation of the combustion wave and their effect on properties of the produced refractory material are explained.

Emission Spectra of Porous Silicate Glasses Excited by Laser Radiation Within SiO_2 Transparence Band

937J0039I St.Peterburg FIZIKA I TEKHNIKA POLUPROVODNIKOV in Russian Vol 26 No 5, May 92 (manuscript received 30 Sep 91, signed to press 28 Dec 91) pp 911-914

[Article by V.N. Beger, V.I. Zemskiy, and A.V. Sechkarev, St.Peterburg Institute of Precision Mechanics and Optics]

[Abstract] Treatment of porous silicate glasses with visible laser radiation (514.5 nm Ar-laser and 632.8 He-Ne laser) within the SiO_2 transparence window has been found to induce wideband intrinsic glow of the matrix (V.N. Beger, 1989), this glow retaining its unusual characteristics after removal of likely foreign organic and inorganic chemical impurities. The emission intensity of these glasses was found to be relatively weak but the spectrum to be strongly asymmetric, stretching into the Stokes region as far as the infrared range and abruptly fading in the anti-Stokes region. Decreasing the excitation frequency was found to decrease linearly the frequency shift of maximum intensity relative to the excitation frequency and symbatically with it the width of the emission band. Soaking in nonfluorescing fluids transparent to visible light such as CCl_4 did not significantly alter the emission characteristics, but curing the pores by several hours of heat treatment at 850° C lowered the emission intensity by a few orders of magnitude by almost completely removing the internal surfaces. This indicates that the emission spectrum is determined by the surface of pores rather than by the glass matrix. Under constant excitation and ambient conditions the emission intensity decreased monotonically to a certain level depending on the excitation intensity, but soaking in darkness caused the emission intensity to exceed its original level at the instant light was turned on again. The degree of emission intensity recovery was raised by longer soaking time in darkness, a shorter soaking time being sufficient at higher temperatures (several hours at room temperature). Measurements covering the 300-500 K range revealed a temperature dependence of the integral emission intensity, its character being determined by both the direction and the rate of temperature change during a heating-cooling-heating cycle. Varying the heating rate during the first heating did not change the path along which the integral emission intensity increased appreciably, but varying the cooling rate did change the return path: 1) during slow cooling (0.1 K/min) the integral emission intensity decreased along the forward path and thus appreciably; 2) during fast cooling (10 K/min) it decreased hardly at all and subsequent second heating returned it to the same level, but following a mild dip attributable to hysteresis. The most likely cause of glow is evidently the presence of many surface defects in porous glass, these defects acting as electron traps and giving rise to localized states within the forbidden band in the quartz component of such a glass. The authors thank Ye.L. Ivchenko for helpful discussions. Figures 3; references 10.

Magnetic and Electric Properties of $CoCr_{2-x}In_xS_4$ Solid Solutions

937D0079A Moscow NEORGANICHESKIYE MATERIALY in Russian Vol 28 No 10-11, Oct-Nov 92 pp 2053-2057

[Article by G.I. Gashimov, A.G. Rustamov, M.B. Gadzhiyev, Azerbaijani State Pedagogical University imeni N. Tusi; UDC 54-115]

[Abstract] The effect of the Cr^{3+} ion substitution in the $CoCr_2S_4$ compound—a typical ferrimagnetic material crystallizing as octahedrons with a normal spinel structure—with In^{3+} ions in the octahedral sites of its lattice on the mechanism of phase transitions and the magnetic and electric properties is investigated. To this end, the magnetization, electric conductivity, and thermoelectromotive force of $CoCr_{2-x}In_xS_4$ samples, where $0<x\leq 1$, are examined. The samples for the study are produced in quartz ampoules by interaction of the initial components. Studies carried out by X-ray diffraction, metallographic, and differential thermal analyses show that all samples are single-phase and have a spinel structure. The lattice cell parameters are examined under a DRON-2 diffractometer in Cu*K* radiation while magnetization is measured at 4.2K by the ballistic method. The dependence of the specific magnetization on the magnetic field strength and the temperature dependence of spontaneous magnetization, electric conductivity, and thermoelectric coefficient are plotted. The findings show that the above substitution leads to the development of ferromagnetism and *n*-type conduction whereby the Curie temperature, magnetic saturation moment, and activation energy of solid solutions all decrease with an increase in *x*. A correlation between the electric and magnetic properties of $CoCr_{2-x}In_xS_4$ is established. Figures 4; references 7: 2 Russian, 5 Western.

Deformation and Fracture Characteristics of Doped Solid Solutions of $Bi_2Te_{3-x}Se_x$

937D0079B Moscow NEORGANICHESKIYE MATERIALY in Russian Vol 28 No 10-11, Oct-Nov 92 pp 2062-2070

[Article by S.N. Chizhevskaya, L.Ye. Shelimova, Metallurgy Institute imeni A.A. Baykov at Russia's Academy of Sciences; UDC 546.87 23 24]

[Abstract] The use of Bi_2Te_3-based materials as thermal energy converters is discussed and the effect such chalcogenides as Bi_2Se_3, Sb_2Se_3, In_2Te_3, In_2Se_3, Y_2Te_3, and CdTe as well as Ge and Cu on the mechanical properties of the $Bi_2Te_{3-x}Se_x$ solid solution (x = 0, 0.12, 0.15, and 0.6) is examined. The dopants are added to the solid solution at a concentration below their solubility limit. The character of deformation and fracture of these solid solutions is analyzed in detail. The composition and bending and compressive strength of solid solutions and their covalent radii and electronegativity are summarized. The dependence of bending strength on the dopant concentration in the charge is plotted. The study makes it possible to identify three hardening mechanisms as a result of compression along the crystallographic axes: due to the development of elastic stresses with introduction of substitutional and interstitial impurities; due to the strengthening of the ionic bond component; and due to the strengthening of bonds between the five-layered packs during the intercalation of copper ions and Van der Waals gaps. The study also reveals the nonmonotonic course of the concentration dependence of the bending and compressive strength which is explained in the framework of the "course" theory. Figures 4; tables 2; references 28: 25 Russian, 3 Western.

On Radiation-Induced Creep of Structural Carbon-Based Materials

937D0079C Moscow NEORGANICHESKIYE MATERIALY in Russian Vol 28 No 10-11, Oct-Nov 92 pp 2075-2079

[Article by Yu.S. Virgilyev, K.P. Vlasov; UDC 621.039.532.21]

[Abstract] Operation of today's structures under exposure to ionizing radiation necessitates the development of new structural materials and calls for studying the radiation-induced creep and long-term strength of carbon-based structural materials (KUM). Three stages of radiation-induced creep are examined: the unsteady, at a rate decreasing with time; the steady, at a constant rate; and the accelerated, at an increasing rate leading to failure. Attention is focused on the latter stage since it is the most crucial and least known of the three. The dependence of the rate of adjusted radiation-induced steady-state creep on the irradiation temperature and the dependence of the creep flow of the AGOT graphite on the neutron fluence at 420K under various loads are plotted. The graphitization degree, compressive strength, density, and electric resistivity anisotropy in two direction relative to the blank height as a function of the irradiation temperature for GR-280, VPG, SPP, SVP, and Carboxylar are summarized. An analysis shows that the steady-state creep rate in a nongraphitized material is higher than that of graphite by fivefold. A discrepancy between the experimental data is noted and it is shown that neutron irradiation accelerates the creep process at the third stage whereby the creep flow is linear relative to the fluence and the creep rate depends on the applied stress to the power of 0.5. Figures 3; tables 1; references 12: 8 Russian, 4 Western.

Production of Titanium Diboride Powder From Titanium Chips

937D0079D Moscow NEORGANICHESKIYE MATERIALY in Russian Vol 28 No 10-11, Oct-Nov 92 pp 2086-2091

[Article by Yu.V. Levinskiy, A.P. Petrov, Moscow Institute of Fine Chemical Engineering imeni M.V. Lomonosov; UDC 546.823.271]

[Abstract] The outlook for using titanium diboride powder for producing high-temperature heat-resistant tool alloys and abrasive materials is outlined, and the possibility of producing titanium diboride powder from titanium chips by embrittlement under annealing in an oxidizing medium is studied; the powder composition and properties are examined. Industrial titanium chips are used as the source material, and titanium diboride powder is made from a mixture of TiO_x powders. To clarify the mechanism of the processes occurring under heating, a strain gauge study of four initial mixtures is carried out. The results of strain gauge study are plotted as pressure vs. temperature vs. time curves. The composition of the initial mixtures, the effect of the synthesis temperature on the carbon and oxygen content in the TiB_2 powder, the effect of the original TiO_x particle size on the impurity concentration in TiB_2, the dependence of the C and O concentration in TiB_2 on the TiO_x composition and component ratio in the original mixture, and the effect of the grinding duration in the vibration mill and magnetic rotator on the mean size of the TiB_2 particles and the impurity concentration are summarized. The data show the titanium chips are a promising material while TiB_2 made from it has a low impurity concentration and is highly disperse. Figures 1; tables 6; references 4.

New Borides With Er_3CrB_7 Structure and Correction of Y-W-B System Constitution Diagram

937D0079E Moscow NEORGANICHESKIYE MATERIALY in Russian Vol 28 No 10-11, Oct-Nov 92 pp 2092-2095

[Article by S.I. Mikhalenko, N.F. Chaban, Yu.B. Kuzma, Lvov State University imeni I. Franko; UDC 546.27.78.641.662]

[Abstract] A new Er_3WB_7 boride with a structure of Er_3CrB_7 is discussed, and Y-W-B and Ln-W-B systems are examined in order to identify other borides with this structure in them and correct the constitution diagram. To this end, 15 samples of the Y-W-B and five samples of the Ln-W-B system are made. The lattice cell parameters of the new borides, the results of X-ray diffraction analysis of the borides in Cu*K* radiation, and the atomic coordinates and temperature parameters in the boride structure are summarized. The isothermal cross section of the Y-W-B constitution diagram at 1,000° C and the change in the boride lattice cell parameters with the Ln ordinal number (where Ln=Gd, Tb, Dy, Ho, Tm, and Lu) are plotted. The findings confirm that the structure of Ln_3WB_7 belongs the Er_3CrB_7 boride class. Figures 2; tables 3; references 5.

Short-Range Order in Ti-Nb-C System Alloys

937D0079F Moscow NEORGANICHESKIYE MATERIALY in Russian Vol 28 No 10-11, Oct-Nov 92 pp 2100-2102

[Article by D.Ya. Khvatinskaya, V.S. Presman, M.Yu. Tashmetov, V.T. Em, Nuclear Physics Institute at the Uzbekistani Academy of Sciences; UDC 539.27]

[Abstract] The factors which determine the short-range order and the effect of this structure on the material parameters are discussed and the multiple-particle correlations in Ti-Nb-C alloys are examined by a neutron diffraction study of $Ti_{0.7}Nb_{0.3}C_{0.98}$ produced by self-propagating high-temperature synthesis and a similar study of $Ti_{0.79}Nb_{0.22}C_{0.63}$ produced by sintering. PTM titanium powder, TU 48-4-284-73 niobium, and lamp carbon black are used as the source materials. The neutron diffraction study is carried out in a diffractometer with a ten-detector system. The neutron diffraction patterns of Ti-Nb-C samples are plotted. An expression is derived for the structural factor and it is speculated that no unambiguous conclusion can be drawn about the atomic distribution in each sublattice. The Ti atoms are shown to have a tendency to surround themselves with oxygen atoms while Ni atoms—with C vacancies. The appearance of a new degree of freedom in the redistribution of atoms principally alters the character of their mutual position. In all, the atomic interaction in the system is pairwise (Coulomb's) and is complex and multi-particle; this fact must be taken into account in analyzing phase diagrams of transition metal alloys. Figures 1; tables 1; references 3: 2 Russian, 1 Western.

Electrophysical Properties of Ln_3EO_7 Compound (E is Nb or Ta)

937D0079N Moscow NEORGANICHESKIYE MATERIALY in Russian Vol 28 No 10-11, Oct-Nov 92 pp 2242-2244

[Article by V.P. Sirotinkin, I.Ye. Animitsa, Moscow Engineering, Electronics, and Automation Institute; UDC 661.888+537.7]

[Abstract] The lack of structural studies of single crystals of the Ln_3EO_7 compound (where Ln is La through Lu and E is Nb or Ta) and the discovery of phase transitions for Ln-La, Pr, Nb, Gd, and Sm prompted an attempt to determine the electrophysical characteristics of the compound, determine the temperature dependence of the electric conductivity and transport number, and compare them for different compound groups. To this end, ceramic oxide samples are prepared, and the electric conductivity is measured by the two-contact method using Pt electrodes in the air with the help of an R5058 alternating current bridge at a 1 kHz frequency. The temperature dependence of the total electric conductivity of various compounds and the temperature dependence of the sum of ionic transport numbers are plotted. The study reveals that changes in the compounds' conductivity with temperature are similar are do not depend on the radiographic characteristics of the individual compounds. The differences are due by the presence of rare earth elements (r.z.e.) which have a tendency toward variable valency. The findings also confirm that the compound undergoes a phase transition within a 780-840° C range which is probably due to a change in the structural type of the compound. Figures 3; references 5: 3 Russian, 2 Western.

Structure and Properties of Heat-Resistant KhN62BMKTYu (EP-742) Alloy

937D0087A Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 11, Nov 92 pp 20-23

[Article by Ye. A. Maslenkova, S. B. Maslenkov, Yu. V. Solovyev, and A. V. Logunov; UDC 669.14.018.44]

[Abstract] The heat resistance, mechanical properties, and structure of a forging made from KhN62BMKTYu alloy were studied. The forging, which was 600 mm in diameter, was made by drawing and upsetting an ingot 400 mm in diameter. The forging was then subjected to seven different quenching and aging combinations varying from quenching alone at 1050, 1100, or 1150° C to quenching at these temperatures plus aging at 850/780° C. The alloy's properties were determined on tangential specimens cut from the test forging. It was found that strength and impact toughness were optimized when the alloy was quenched at 1100° C for eight hours, aged at 850° C for eight hours, and aged again at 780° for 16 hours. Plasticity was virtually unaffected by quenching temperature. The best combination of strength, plasticity, and impact toughness was found in double-quenched, double-aged alloy specimens and proved to be superior to that of KhN73MBTYu and other alloys widely used to make gas turbine disks, thus making it possible to raise the temperature of their operating environment. Figures 1, tables 6; references 5: Russian.

Boundary State and Failure Characteristics in Powder Iron-Manganese Alloys

937D0087B Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 11, Nov 92 pp 24-28

[Article by T. F. Volynova, I. B. Sidorova, and I. Z. Yemelyanova; Central Scientific Research Institute of Ferrous Metallurgy imeni I. P. Bardin; UDC 669.15'74:621.762]

[Abstract] The effects of impurities on structural transformations and failure characteristics were studied in powder Fe-Mn alloys containing 4 to 32 percent Mn. The nitrogen-atomized powders were hot-extruded to form bars from which test specimens were prepared. The specimens were heated at 600, 700, 800, 900, 1000, 1100, or 1200° C for 30 or 120 minutes and water-quenched. Metallographic analysis was performed on a Neophot-3 microscope. Element particle and grain concentration and distribution were determined on a Jeol Jamp-10S scanning Auger spectrometer. Specimen foils were studied on a Tesla BS-540 electron microscope, and fractographic analysis and quantitative analysis of impurity distribution on the fracture surfaces was performed on a Jeol JSM- T300 scanning electron microscope using a Link X-ray microanalysis system. It was found that boundaries in powder materials play a crucial role in the nature and characteristics of defects, including crack origination and propagation and the development of intergrain failures. Both inter- and intra-particle grain boundaries were observed. A shift in the failure mechanism from inter- to intra-boundary is largely determined by the temperature from which the alloys are quenched, which in turn determines when the carbon and oxygen impurities begin to dissolve and impact toughness reaches its highest values. This temperature was found to be 900° C for the finer fraction compositions and 1000° C for the coarser fraction compositions. Figures 5, tables 2; references 4: Russian.

Structure and Properties of Powder Materials in the Fe-Cr-Cu-C System

937D0087C Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 11, Nov 92 pp 28-30

[Article by N. A. Nikishov, I. V. Bogolyubova, and S. Yu. Lopukhin, Scientific Production Association of the Scientific Research Institute of Automotive Technology; UDC 669.15'3'26:621.762]

[Abstract] The effect of chromium concentration on the structure and properties of Fe-Cr-Cu-C systems was studied in a powder composition containing 1.5 percent C, 1 percent Cu, and 2, 6, and 10 percent Cr. The size of the original iron particles was 30 to 100 μm, and 3 to 10 μm for the chromium. Specimens of the three compositions were sintered in an Rx gas atmosphere at 1140 and 1230° C for 0.5 h, slowly heated for 1.5 h, and slowly cooled for 1.5 h. After sintering at 1140° C, all the specimens were observed to have pearlite and "light-colored" regions with sharply defined boundaries, and the specimens with 2 percent Cr had a weakly developed white reticulate process along the iron particle boundaries. Increasing the sintering temperature from 1140 to 1230° C promoted saturation of the iron with chromium, transformation of the perlite matrix into an austenitic-martensitic matrix after cooling, and the formation of chromium carbides with greater thermal stability ($Cr_{23}C_6$ versus Cr_7C_3). Increasing the chromium concentration from 2 to 10 percent, regardless of sintering temperature, promoted the formation of larger light-colored areas that formed a greater percentage of specimen volume, and, in turn, these areas had a higher percentage of chromium-based carbides. The porosity of the sintered material was found to depend on the chromium concentration and sintering temperature. At the lower temperature, porosity increased as chromium concentration was increased; the reverse was true at the higher temperature. Thus, by varying the chromium content and sintering different structures and properties. Figures 3; references 3: Russian.

Mechanical Properties of 30KhGSA Steel After Combined Laser Treatment

937D0087D Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 11, Nov 92 pp 35-36

[Article by P. Yu. Kikin, A. I. Pchelintsev, and Ye. Ye. Rusin, Institute of Mechanical Design, Nizhnenovgorod Affiliate; UDC 669.14.018.298:621.373.826]

[Abstract] The effects of combined shock-wave and laser treatment on the mechanical properties of 30KhGSA steel were investigated under both static and dynamic loading conditions. The specimens were first subjected to shock-wave laser radiation from a Q-switched ruby laser. Power density was 10^7 W/sq cm, which made it possible to obtain an impulse pressure of 1 GPa. After shock-wave treatment, the specimens underwent laser heat-treatment by a pulsed solid-state YAG:Nd^{3+} laser with a power density of 5 x 10^4 W/sq cm and a pulse length of 7 x 10^{-3}. The laser treatment zone overlap factor was 0.5. As a result of the combined treatment, finely-dispersed martensite formed in the surface layer of the steel, a result that could not be achieved with laser quenching alone. The hardness of the surface layer also increased relative to similar characteristics obtained with conventional laser heat-treatment. Figures 1; references 6: Russian.

Strength and Plasticity of VT1-1 Engineering Titanium at 0 to 600° C

937D0087E Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 11, Nov 92 pp 36-37

[Article by V. P. Krylov and Z. L. Zlatin, Kirov Plant Production Association; UDC 669.295:620.172]

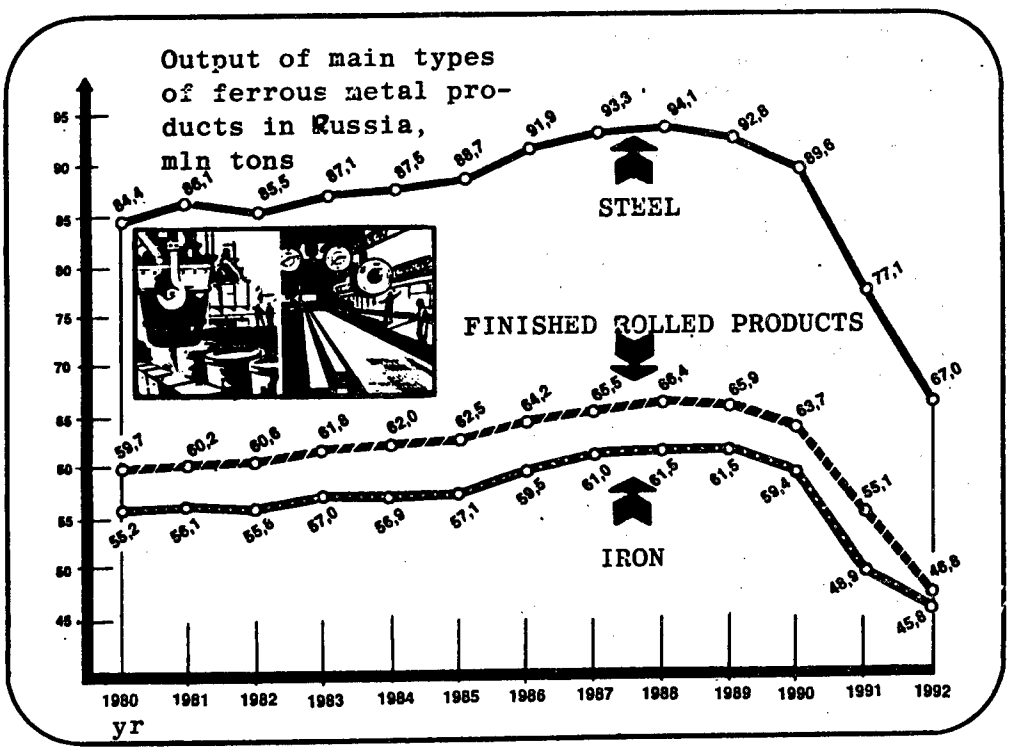
[Abstract] The mechanical properties of engineering titanium with an initial hydrogen concentration of 0.009 percent and a hydrogen concentration of 0.025 percent after supplemental saturation were studied in gauge length 5 test specimens 6 mm in diameter. The specimens were prepared from billets with a cross-section of 15 by 15 mm annealed at 650° C. Mechanical testing was performed at constant loading rates of 2.4 x 10^{-5} s^{-1} and 1.1 x 10^{-3} s^{-1} at temperatures ranging from 20 to 500° C at 25 to 50° C intervals. Regardless of the loading rate or hydrogen concentration, the behavior of all three properties measured—yield strength, percentage reduction of area, and percentage elongation—was very similar. The only differences in yield strength values, which decreased as the test temperatures increased, were seen at temperatures below 150° C. Percentage reduction in area had a well defined minimum at 100° C, increased until it dropped off a little at 400° C, then continued to climb. Percentage elongation moved in different directions as test temperature increased, but tended to decrease until the test temperature reached 400° C, after which it climbed sharply. Figures 2; references 2: Russian.

Industrial Policy of Russia

937D0093A Moscow EKONOMIKA I ZHIZN in Russian No 4, Jan 93, pp 1-4

[Article by A. Shupunov, president, Defense Enterprise Assistance League: "Industrial Policy of Russia"]

[Text]*The reasons for the economic crisis, the solutions to it, and the immediate future of Russian industry are interpreted in different ways, which often results in diametrically opposite evaluations.*



Neither the heat of political discussion at congresses of people's deputies nor the "hand-to-hand" skirmishes at sessions of the RF [Russian Federation] Supreme Council and government meetings have given society answers to vital questions. So I have attempted to explain, if not the entire issue, then at least certain parts of it.

What will Russian industry and the economy be like in 10 years? How will Russia look to a citizen of Russia who has worked his entire life in industry—to me and many of my colleagues—in the future? A state with a powerful industry capable of competing in the world market and worthy of a great power? Or will industrial stagnation continue? It is industrial potential interacting with the agrarian section that will determine the overall way of life of Russia in the 21st century.

Under market conditions the Russian economy (industry, the agrarian sector, the entire financial and credit system infrastructure, insurance, etc.) must be a self-organizing, dynamic mechanism highly resistant to adversities, adaptable to market fluctuations, and balanced in terms of the production of both consumer and industrial goods.

Moreover, the Russian economy must have firm positions on the world market and increase exports to 10-12 percent of the GNP. Large diversified corporations are the basis of this kind of an economy.

One does not have to look far for examples. Take the US companies Chrysler and Hewlett-Packard in the 1980's and in the 1990's IBM, Thompson, Dasso, and many other deeply diversified companies capable of successfully coping with a temporary decline in production in some areas because of high profits in other sectors. I may be so bold as to say that one of the main factors in the success of these companies is the correct choice of company organizational structure. These companies—even in crises—were able to remain "afloat" without significant government assistance. At this stage our industry is represented solely by the "samoyed" structure of enterprises narrowly specialized by branch, while all industry is weighted toward group "A" (70-80 percent). Moreover, Russian industry has almost no export products (in 1992 machine building represented only 6 percent of total Russian exports).

The overwhelming percentage of industrial and agrarian enterprises is state- owned and in the next 3-5 years will determine the state of our economy, its stability, the volume of goods on the domestic market, and the mood of society. Like it or not, we have to take this objective reality into account.

When speaking of the restructuring of Russian industry, I mean primarily the process that will put production of group "B" goods in the lead in the economy, reaching 50-60 percent of industry's share. This restructuring is inevitable, but it will require huge investments (about 80-100 trillion rubles) and is therefore hardly likely given the decline of production.

What should we set up? What should the makeup of enterprises in the new Russian industry be? Either it must be primarily small and medium-size enterprises, as some suggest, or the industrial monsters, narrowly specialized, inflexible, inert, that we know now. In our opinion, neither approach to restructuring is appropriate.

We believe that it is more correct to base it on thoroughly diversified large industrial companies which incorporate into their structures banks, insurance companies, and large enterprises. Fifty to sixty such industrial-financial groups can be created in Russia. But this industrial restructuring will not happen spontaneously. State management of the restructuring of Russian industry and a policy supporting and protecting national producers of goods and stimulating production of goods are needed.

It is also vital to choose the correct method for restructuring. There are two approaches to this problem—western (evolutionary) and eastern (revolutionary). The evolutionary methodology was used by large diversified industrial structures created from the 1930's through the 1950's (the United States, France, Germany). The eastern restructuring methodology (Japan, South Korea, Malaysia, Singapore, Taiwan) made it possible to establish large diversified world-class companies such as Gold Star and Daewoo in 15-20 years. But this process took place under the direct supervision of the government with a strict policy of government protectionism toward national industry.

There is no question that industrial restructuring in Russia will have its own unique features, but it would be foolish not to take into account similar experience in the East and West.

Unfortunately, 1992 was wasted as far as industrial restructuring is concerned, although our recommendations were submitted for the government's consideration. But for the first six months no one in Gaidar's government was responsible for industrial performance, and in the second it was busy restructuring upper level management—ministries were combined, departments created and then abolished. Because of this restructuring industrial management was totally wasted. The most experienced, skilled management personnel left, and costly time for reform was wasted on coordination, shakeups, reshuffling, re-appointments, i.e., on fuss, while the departments' operating style did not change. They were more accustomed to operating in the old way. And newly created management bodies (committees) don't smell of industrial restructuring. It turns out that "those on the bottom don't want to live the old way, but those at the top can't live the new way."

The Defense Enterprise Assistance League officially presented its proposals for restructuring industry to the RF government—V. Shumeyko, A. Nechayev, A. Titkin, but, as they say, there they remained.

Foreign Economic Activity

In 1991-1992 there was a sharp decline in Russian heavy machinery exports. Haevy machinery accounted for 17.5 percent of exports in 1990, 7.1 percent in 1991, and 4.6 percent in the first six months of 1992. There is a noticeable trend toward further reduction in 1993.

The significant drop in Russia's foreign trade turnover, and especially in the export of heavy machinery products, military equipment, and weapons, has led to serious domestic economic and political difficulties. There are many reasons for the drop in exports. They include the general decline in industrial production and changes in the structure of internal prices, which disturbed the positions of machinery manufacturers and of goods manufacturers in general. The lack of an industrial policy stimulating the growth of exports. The creation of a legal, financial, and administrative atmosphere in the government that encourages the flight of capital and resources from production and export. Blocking the basic form of integrated machinery export—technical cooperation with western competitors—excludes Russia from her traditional markets. Excluding Russia from world machinery and weapons trade leads to a loss of tremendous hard currency reserves. These losses cannot be compensated by any foreign aid or credits.

The combination of all these adverse structural factors prevents us from counting on the rapid recovery of traditional Russian heavy machinery exports. But in terms of several products Russia retains considerable competitive potential, especially in third world countries.

The restoration of a high level of machinery and defense industry exports is therefore one of the key factors in overcoming the country's socioeconomic crisis and in restoring the prestige of Russia as a great power.

Solution of this problem requires a long-term strategy and goal-oriented policy. **First,** the Russian economy must confront the task of systematically increasing exports to 10-12 percent of the GNP, including at least 25 percent machinery. Processes, services, and know-how should be exported, not just machinery and equipment. Moreover, it makes sense to implement a conscious policy of selling "today's" finished products, the latest equipment, in order to support the development of "tomorrow's" models. All things being equal, preference should be given to expanding collaboration with foreign partners under technical cooperation programs.

Second, the concept of foreign economic activity must be developed in each region to take into account its specific features; our positions in traditional regional markets must be restored, and ways to enter new markets must be outlined.

Third, we have to select "breakthrough" items (products, technologies, materials) that match or surpass the world standard and flood the world market with them. By focusing on them all our export efforts, we can, by exporting them, develop a mechanism for opening up the foreign market. Special attention should be given to selecting a strategic trading partner who owns the market and, with his help, creating mixed companies and consortia. We should provide government support for exporting "breakthrough" items by concentrating it in competitive sectors of the Russian economy such as the aerospace, laser, and nuclear industries, shipbuilding, information services, cartographic and geodesic surveying, and geological exploration.

Fourth,, legislative support and protection of the interests of Russian export and improvements in the forms and methods of foreign economic activity are also very important. In this regard we must essentially create a new legal basis for supporting and increasing Russia's exports, starting with the signing of economic-trade agreements and most favored nation agreements and ending with agreements on a systems of accounts among ruble-zone states.

Fifth, we need an extensive export infrastructure: a network of commercial export-import banks, industrial-financial investment companies oriented toward individual countries and regions of the world market (primarily eastern Europe, China, India, and other countries with nonconvertible currency), insurance companies, and legal offices.

Sixth, the development and implementation of a state program for training skilled personnel on all levels for participants in foreign economic activity (central agencies, foreign trade associations, regions, non- specialized organizations) are vital, as is promoting the development of a network of specialized institutions attracting technical assistance from abroad.

Seventh, problems ensuring standardization of heavy machinery and their high quality demand special attention if Russian machinery export is to succeed. We know well that we haven't always taken these problems seriously on the domestic market, and in individual cases a contemptuous attitude even developed. For export a domestic producer cannot have this attitude. It leads the buyer to reject our products and to negative publicity, and it reinforces the opinion that Russian enterprises are both unreliable and negligent partners. This is in no way acceptable. Special measures are needed to improve the quality of exported products, as is strict adherence to state standards. Moreover, it makes sense in individual cases to meet the standards of the buyer's country. This task is well within the powers of our industry.

The priority in increasing exports is financing. The financing of the export of technical cooperation and military hardware, which is primarily done through state-supplied credit, is in a particularly serious state. Therefore, given the industrial decline and the still extremely flawed market infrastructure, state control of the process of developing Russian exports is simply necessary.

The necessary provisions of state support should include: preferential credits to export sectors of the economy, state guarantees to finance export operations, and the creation of conditions under which our exporters can overcome various non-tariff barriers to entry into foreign markets.

All these factors indicate that a state program for stimulating and developing export on the basis of these principles must be developed and approved.

Reform Mechanisms

We know that making a decision or passing a law doesn't mean much. It has to be carried out. The distance between a decision and its execution is usually huge. We need people and procedures for carrying out decisions and monitoring their implementation and timely feedback on their implementation.

The government should not isolate itself from producers. On the contrary, it must take the pulse of the economy every day, know the true reaction of specialists and the public to decisions (not only in Moscow, but in other regions of the country), and develop a timely response to this reaction. We need mechanisms for implementing the decisions that have been made.

A typical example of the inability or lack of desire to do things as they should be done is the process of Russian conversion in 1992. It was a chaotic and inefficient failure. It turned out that we had everything necessary for organized conversion in Russian: state and regional conversion programs, specific amounts of money allocated for conversion, and, of course, a law on conversion. But there is almost no conversion, since there is no specific mechanism for carrying it out. The procedure for and the approval of state and regional conversion programs have not been defined, and even the responsibility for this part of the work has been split among the Ministries of the Economy and Industry, the Higher Economic Councils of the RF Supreme Council, and the Conversion Committee of the RF Supreme Council. The situation is even worse with the distribution of money allocated from the country's budget and special credit for conversion.

For example, as a result of the lack of a mechanism for distributing preferential credit issued to industry in April, 1992, only about three- fourths of the money allocated was actually paid out, and no more than 10 percent actually reached the enterprises. It has been calculated, for example, that the efficiency of conversion investments into the development of domestic computers and information processing was only 0.37 percent. Our market continues to be filled with hardware and software from IBM and its subsidiaries. But there were plenty of proposals for a mechanism to control conversion.

In the government, V. Shumeyko could assume responsibility for conversion, and the Ministry of the Economy should establish a unique staff headed by the first deputy minister, to whom this important matter would be assigned.

Conversion money should be given only for specific, approved conversion programs. No other structure should interfere in managing conversion and, if necessary, managers should be involved only for consultation. Unfortunately, no one in the government wants to take on this job. The example of conversion shows that the government has now forgotten the a-b-c's of management science. This matter should be correctly immediately. And at each part of the reform, in its key areas, we must define the personal responsibility of the appropriate officials and approve the appropriate mechanism for carrying out decrees, decisions, and laws. This is where a good professional staff is needed. Underestimating the government apparatus leads to a weakening of the state's functions in exercising power and, in the worst case, to the loss of state control of the reform

Ferrous Metallurgy of Russia

937D0093B Moscow EKONOMIKA I ZHIZN in Russian No 4, Jan 93, p 5

[Article by O. Soskovets, chairman, Russian Federation Committee on Metallurgy; S. Afonin, chairman of the board, "Metallurgprom"; V. Astrakhantsev, department head, Institute for Ferrous Metallurgy Economics: "Ferrous Metallurgy of Russia: Failure in Competitive Struggle or National Priority?"]

[Text] ***In the transition from a centrally controlled to a market economy, Russian ferrous metallurgy is, like other branches, characterized by disturbing performance results. These include the significant decline in output primarily in the most skill-intensive kinds of products, a sharp rise in prices for the product itself and for resources, a deterioration in the supply of energy sources, raw material, materials, spare parts, and equipment, acute financial problems in terms of huge defaults on payments for product shipped, and the almost total halt to capital construction. Political upheavals and the breakdown in economic relations with enterprises in former union republics have contributed significantly to the development of the crisis in the branch and in the entire economy.***

Furthermore, the need to switch to a market economy and to open it to the world economy are unquestionable. As a result, branch enterprise face several new problems, the most important of which is product competitiveness.

Today the question is a harsh one: Will Russian ferrous metallurgy survive in the competitive struggle with western European and American metal producers and especially with those in the Asia-Pacific region?

Let us present the basis parameters of the Russian ferrous metals market and the results of an analysis of domestic metal products from the standpoint of their competitiveness.

Our country is only beginning to form a ferrous metals market. Russia has 37 specialized metallurgical enterprises producing finished rolled products and 14 producing steel tube. Of these, 24 producers of rolled stock and 10 of steel tube are included in the Russian Federation State Register of Associations and Monopoly Enterprises. In 1990 they accounted for 89.2 percent of the production of finished rolled products and 90.8 percent of steel tube.

Thus the Russian ferrous metals market is an oligopoly, but also a monopoly in terms of several kinds of metal products. There is almost no competition, and branch specialists are not concerned with competitiveness. Nevertheless, Russia is an active participant in international ferrous metals trade. In 1991 it exported 3.44 million tons of iron, 1.4 million tons of semifinished steel products, 2.31 million tons of finished rolled products, about 300,000 tons of ferroalloys, more than 71,000 tons of steel wire and 84,000 tons of steel tube, and more than 700,000 tons of ferrous metal scrap and wastes. The value of the exports exceeded 3.7 billion rubles. Russia imported 1.46 million tons of finished rolled stock and 1.8 million tons of steel tube, as well as many other metal products. Total ferrous metal imports in 1991 were 3.7 billion rubles, i.e., almost equal to our exports.

According to data from VO "Promsyryeimport" the prices for ferrous metallurgy products exported from Russia in 1992 under contracts signed by this association are on the level of European market prices or slightly lower (iron, $112-113; ferroalloys, $309; steel ingots, $147-148; rolled products, on the average $211; tube, $332; ordinary wire, $323). After elimination of the state monopoly in foreign trade, the association's share of ferrous metallurgy trade declined sharply because the metallurgical enterprises themselves, as well as many intermediary organizations and ferrous metal users who wanted to sell surplus metal, entered the market. The amount of ferrous metal on the world market sharply increased, which led to a drop in prices, as well as to the initiation of anti-dumping processes against Russian suppliers.

The trade structures of Russian ferrous metals exports and imports are extremely different. Semifinished products, iron, ferroalloys, semifinished steel, and ferrous metal scrap and wastes play a major role in exports—up to 71 percent by weight and 55 percent by value, but flat-rolled sheet accounts for most of the imports: up to 43 percent by weight and 40 percent by value; steel tube—up to 55 percent by weight and 58 percent by value. Cold-rolled sheet traditionally accounts for most Russian imports of finished rolled products—1.055 million tons, or 72.5 percent.

The structure of ferrous metal exports and imports clearly reflects the basic problems in the evolution of Russian ferrous metallurgy: the inadequate quality of the final kinds of metal products and the scarcity of high-quality metal products, especially cold-rolled sheet. This structure is a result of the inadequate competitiveness of domestic finished metal products compared to those from mills in Europe, North America, Japan, and South Korea.

In an analysis of the level of competitiveness, special attention should be given to metal product quality parameters, including those formalized in standards. Our standards contain requirements for quality on the level of ISO international standards and similar standards in developed countries—the United States, Japan, FRG, France. They match international standards in terms of acceptance and in methods for inspecting and testing steel products. In some cases requirements for individual indices, e.g., the sulfur and phosphorus content of steel, are more rigorous.

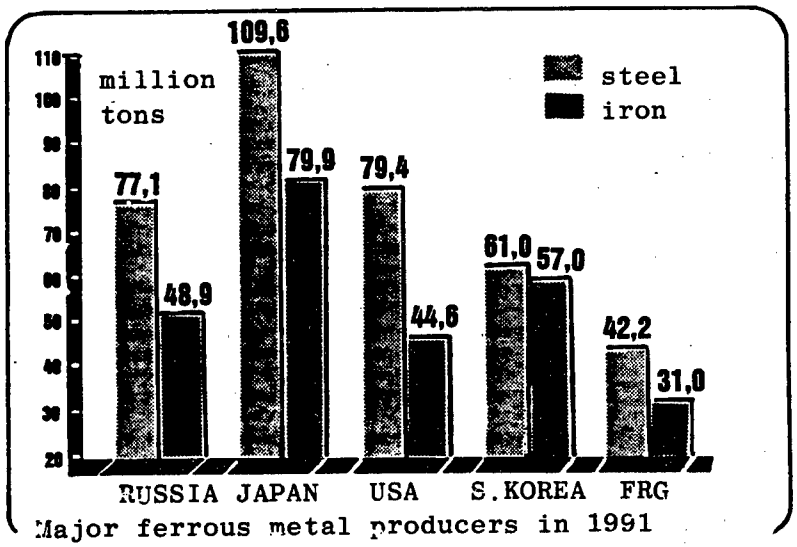
This makes it possible to propose delivery to the world market of metal products on the basis of both domestic and international, or the national, standards of other countries. Today this is a necessary condition for entering the world market.

Product certification—the conclusion by a specialized certification organization that a manufacturer's product consistently meets the requirements of standards, specifications, and contracts—is becoming increasingly important in world practice. Experience shows that only certified products can be sold at world market prices today.

Therefore, in 1991-1992 Russia's advanced metallurgical enterprises conducted certification of individual kinds of rolled products by inviting foreign certification societies with the active participation of the TsNIIchermet [Central Ferrous Metallurgy Scientific Research Institute] Center for Standardization and Certification. Several mass-produced metal products were certified at integrated metallurgical works—Magnitogorsk, Novolipetsk, Cherepovetsk, and Nizhnetagilsk, as well as at specialty steel mills— Elektrostal, Oskolsk Electrometallurgical Works, and Chelyabinsk Metal Works. These products included: rolled plate, including that for shipbuilding and pressure vessels; rolled shapes—flange beams and channels; tube blanks, forging, bars made from high-quality structural and stainless steels; cold-rolled strip and cold-drawn stainless steel; and high-temperature and heat- resistant steel. Russian enterprises' total capacities to make products certified to foreign standards are already about 5.7 million tons, or about 8.5-10 percent of rolling capacities.

The markets in developing countries are distinguished by less stringent requirements for metal product quality, which allows us to consider the export potential of Russian ferrous metallurgy as broader than the amount of metal products limited to certified kinds. Unfortunately, there are absolutely no certificates for domestic steel tube or for products from enterprises in the "Prommetiz" concern.

By 1995 the amount of metal products certified to standards of countries with developed metallurgy may actually reach 15-16 million tons; by the year 2000,



Major ferrous metal producers in 1991

17-18 million. This will be 21-23 and 25-27 percent of Russia's available productive capacities.

Other key factors in competitiveness in addition to metal product quality indicators are: production costs (self cost); transfer prices (in the long run they follow production costs); organizational factors—the ability to delivery "just in time," marking and packaging according to the buyer's requirements; the exchange rate for hard currencies and the rate of inflation in these currencies; the tax system in the exporting and importing countries; and export-import regulations—duties, quotas.

At the current ruble-to-dollar exchange rate, domestic prices for steel products are incomparably lower than those on the world market. This situation makes it attractive to export it from Russia even at low prices in SKV [freely convertible currency]. For example, at a rate of 450-500 rubles per dollar, the price of cold-rolled sheet, $400 a ton, is 180,000-200,000 rubles. On the domestic market, however, it is only 25,000-30,000 per ton, while actual production expenses are about 22,000-26,000 rubles.

Domestic ferrous metallurgy is distinguished by higher consumption of material, fuel, energy, labor, and other resources compared to metallurgy in the developed countries. In particular, steel consumption to produce 1 ton of finished rolled stock in Russia is 1.242 tons; in Japan, 1.044 tons; and in the United States, 1.189 tons. This fact is attributable primarily to Russia's low use of continuous steel casting technology—24.6 percent of the total, while this figure is 94.4 percent in Japan and 75.7 percent in the United States.

When evaluated in terms of world prices, energy costs are a major component of the net cost of domestic finished rolled products. According to the Institute for Ferrous Metallurgy Economics, the total (start-to-finish) energy content of 1 ton for the group of mills comparable to foreign ferrous metallurgy is 30 percent higher than in Japan. This means that, according to rough estimates, energy costs represent $85-188 of the self cost of 1 ton of domestic rolled product. Energy costs as a percentage of the net cost of domestic finished rolled products are high: from 30 to 40 percent, which is unprecedented in world practice. For example, it is only 22 percent in ferrous metallurgy in the FRG.

The cost of labor at domestic metallurgical enterprises is also high. It takes 8.5-15 manhours to produce 1 ton of finished rolled product, which is 1.3-2.3 times higher than in countries with developed ferrous metallurgy. Because of low labor productivity at Russian ferrous metallurgy enterprises, domestic metal products can be competitive only at the very lowest wages in countries with developed ferrous metallurgy—South Korea, Brazil, and Taiwan— $5.30 per hour, which is 19-30 percent of that in more developed countries. The hourly wage at Russian metallurgical enterprises is an order or magnitude lower.

Given the western European wage ($19.60 per hour), labor accounts for almost 50 percent of the total costs to product domestic metal products, and Russia's ferrous metallurgy products are uncompetitive on the world market in terms of production costs.

Thus, given the relatively sorry state of fixed capital and the lower technical and technological level, domestic metallurgy's chances to win the competitive struggle in terms of production costs today are not high.

Ferrous metallurgy's role should be evaluated from the standpoint of national interests and national security, both economic and state. From this viewpoint, the high percentage of foreign producers on the domestic ferrous metals market is unacceptable. In the U.S. economy's worst years, for example, ferrous metal imports did not exceed 18 percent of domestic consumption. It must be

stressed that Russia's ferrous metallurgy has the requisite material, fuel, and labor resources, production apparatus, and scientific and technical potential for successful development, and consumers have every reason to rely on domestic metal products.

Ferrous metallurgy is distinguished by high material, capital, energy, and labor contents, which results in a certain inertia in its evolution and makes it impossible to carry out the necessary technological and organization restructuring of the branch quickly—in 2-3 years. Moreover, domestic machine building does not satisfy ferrous metallurgy's equipment needs, either in quantity or, especially, quality. Therefore, some time will be needed to modernize Russian ferrous metallurgy.

We are convinced that Russia's economy cannot develop normally on market principles without a national ferrous metallurgy, but it will require support from the government during the modernization period. The branch must become one of the economic priorities in the industrial policy.

This is why, to protect national ferrous metallurgy, a protectionist policy toward the Russian ferrous metals market must be development and carried out. It should be based primarily on economic regulation of the development of domestic production—tax benefits and export incentives—and economic and administrative regulation of imports—import duties and quotas.

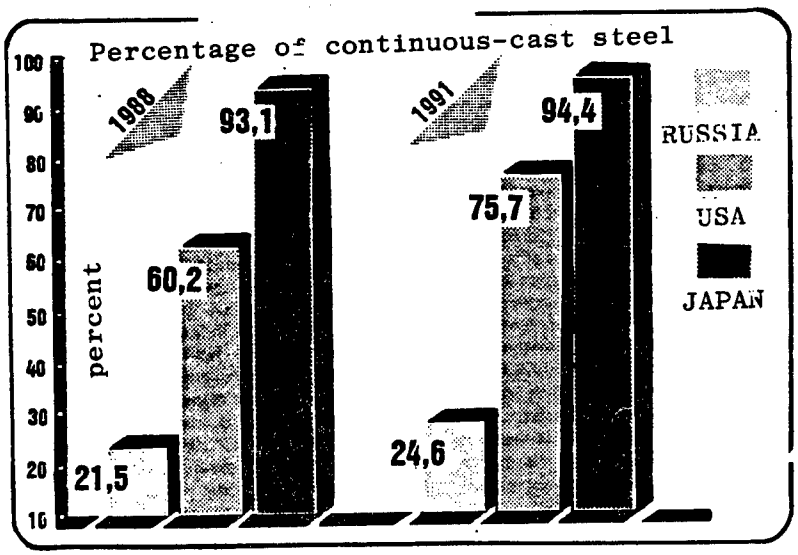
To develop ferrous metallurgy as a branch that will ensure the country's economic security, we must devise a state program for its survival and modernization that would focus on increasing the competitiveness of metal products. The program should cover specific plants and the kinds of products they produce which, within a certain time, must reach a level of quality ensuring production and delivery in complete compliance with the requirements of the foreign market, including certification. The program must ensure that labor productivity and material resource consumption match the best indicators in the rest of the world. Implementing this program over 7-10 years will make it possible to restore ferrous metallurgy to health, make it one of the competitive branches of the national economy, and broaden Russia's export potential. This will permit a gradual relaxation of measures protecting domestic ferrous metallurgy and providing it with state support, which means eventually reducing budgetary expenditures on it.

Effect of Heat Treatment on Structural Perfection of Highly Doped Silicon Single Crystals

937D0094A Moscow NEORGANICHESKIYE MATERIALY in Russian Vol 29 No 1, Jan 93 pp 18-20

[Article by A.F. Shimanskiy, V.F. Kargin, V.S. Shibanov, V.I. Tupayev, T.A. Chembura, V.V. Leonov, Krasnoyarsk Nonferrous Metals Institute imeni M.I. Kalinin; UDC 546.28:548.4.]

[Abstract] The effect of impurities in highly doped semiconductors on the defect formation and an uncontrollable decrease in the majority carrier concentration with attendant changes in the crystal properties prompted an investigation of the effect of heat treatment on the structural perfection of Si single crystals doped with B and P. The study is carried out by taking electrophysical measurements and using methods of qualitative metallography and X-ray spectral microanalysis. Czochralski-grown dislocation-free single crystals produced in a Redmet-15 unit at a 1.5-2.0 mm/min rate in the [111] crystallographic direction are used in the study. The electric resistivity behavior along the B-doped silicon single crystal length and the phosphorus distribution in the crystal volume before and after annealing at a temperature of 1,470K for 10 h are plotted. The samples were annealed in an atmosphere of



argon within a 1,270-1,570K range for 5-30 h at a 1,000K/h rate. The study reveals that the effect of heat treatment becomes noticeable starting at a 1,370K temperature. Annealing leads to a decrease in the number of structure imperfections manifested as etching pits and characteristic bumps on the metallographic section surface. The findings indicate that when the boron and phosphorus concentration in silicon is close to the limit of dissolution, the impurities become polytropic. High-temperature annealing of highly doped crystals thus increases their homogeneity and structural perfection. Figures 3; references 6: 5 Russian, 1 Western.

New $R_3Cu_3Sb_4$ Intermetallic Compounds (R = Y, La, Ce, Pr, Nd, Sm, Gd, Tb, Dy, Ho, Er) With Semiconductor Properties

937D0094B Moscow NEORGANICHESKIYE MATERIALY in Russian Vol 29 No 1, Jan 93 pp 25-27

[Article by R.V. Skolozdra, P.S. Salamakha, A.L. Gansyuk, O.I. Bodak, Lvov State University imeni I. Franko; UDC 548.736.4.538.214:537.312.]

[Abstract] Synthesis of new Au-Sb compounds is reported and the crystal structure and properties of these $R_3Cu_3Sb_4$ intermetallic compounds (where R = Y, La, Ce, Pr, Nd, Sm, Gd, Tb, Dy, Ho, Er) are investigated. The new compounds are produced by fusing the components in an electric arc furnace in an atmosphere of purified argon. A phase analysis is carried out in a DRON-2.0 diffractometer in Cu*K* radiation, the magnetic susceptibility is measured by Faraday's method, the electric resistivity is measured by the two-probe method, the differential thermoelectromotive force is measured by the potentiometric method, and the crystal structure is determined by the powder method. The lattice constants, paramagnetic Curie points, and effective magnetic moments of the compounds are summarized, and the temperature dependence of the resistivity and differential thermal emf is plotted. The effect of the electron concentration (EK) on the compound properties is considered, and it is noted that the R and M metals preserve their coordination. The new compounds are shown to belong to the semiconductor family where the dielectric gap is determined by the electron concentration (equal to 32 per formula unit). It is shown that the new phases can be regarded as derivatives of the MgAgAs phases. Figures 1; tables 1; references 10: 4 Russian, 6 Western.

Phase Transformations in $Ge_3Bi_2Te_6$, $GeBi_2Te_4$, and $GeBi_4Te_7$ Semiconductor Compounds

937D0094D Moscow NEORGANICHESKIYE MATERIALY in Russian Vol 29 No 1, Jan 93 pp 54-58

[Article by L.Ye. Shelimova, M.A. Kretova, Metallurgy Institute imeni A.A. Baykov at Russia's Academy of Sciences; UDC 546.289.87.24.]

[Abstract] At attempt is made to examine the effect of the deviation from stoichiometry in the $Ge_3Bi_2Te_6$ (A), $GeBi_2Te_4$ (B), and $GeBi_4Te_7$ (C) laminar semiconductor compounds on the phase transformations in them. The behavior of these compounds within a 350-700K temperature range and direct and inverse phase transitions occurring in them are discussed, and alloys with various deviations from stoichiometry are studied by dilatometry analyses. The alloys are prepared by fusing the components at 1,073K with subsequent diffusion annealing at 773K for 1,000K. The dilatometry study is carried out in P.G. Strelkov's quartz dilatometer at a 1.5-2.0K/min heating rate. The temperature dependence of the linear coefficient of thermal expansion, the percentage change in the sample volume under heating, and the dependence of the phase transition temperature on the degree of germanium's deviation from stoichiometry are plotted. The findings show that the processes under study are first-kind phase transitions and are used to determine Debye's temperature of the ternary compound on the basis of Sirota's equation and Lindemann's rule. The phase transition temperature decreases with an increase in the Ge, Bi, or Te atom concentration in excess of stoichiometry. Figures 5; tables 3; references 15: 12 Russian, 3 Western.

Correlation of Structure and Optical Properties of Thin Films of ZrO_2-SiO_2 System

937D0094E Moscow NEORGANICHESKIYE MATERIALY in Russian Vol 29 No 1, Jan 93 pp 79-82

[Article by Ye.G. Semin, N.A. Bubnova, N.V. Krivosheyev, M.Ya. Khodos, S.V. Fedorov, St. Petersburg Scientific Research Institute at the Public Utilities Academy imeni K.D. Pamfilov; UDC 546,831-31:539.216.2]

[Abstract] Interest in Zr-containing complex oxides, especially for making thin film coats, due to the possibility to control their physical and chemical characteristics is noted, and the effect of silicon dioxide additions on the optical and physical and chemical properties of ZrO_2-based films is examined within the entire concentration range. The state of the $^{57}Fe^{3+}$ chromophore ion in samples of the ZrO_2-SiO_2 system and dielectric films on their basis is analyzed. The films are produced by electron beam vaporization of a mixture in a vacuum in a URMZ 279.011 unit. The refractive index and film thickness are measured by known methods and spectral curves are recorded by an AQW-Shimadzu spectrophotometer. The surface structure is studied under an EM-802 electron microscope by the Pt-C replicas method, and the structural transformations are investigated under an ER-100 electron diffraction analyzer using a scanning device. The film composition is examined by Auger spectroscopy with layer-by-layer etching. The existence of the $ZrSiO_4$ compound in the system is noted. The infrared spectra, transmission spectra, and X-ray photoelectron spectra of the films with various

compositions are plotted. Silicon dioxide-doping of zirconium dioxide makes it possible to produce films in which Zr is in a more oxidized state, thus lowering the ultraviolet and visible light absorption. Homogeneous films with a 1.54-1.56 refractive index are produced at a silicon dioxide concentration of 96-99 percent. Figures 3; tables 1; references 13.

Effect of Laser Irradiation on Phase Composition of Thin Transition Metal-Silicon Films

937D0094F Moscow NEORGANICHESKIYE MATERIALY in Russian Vol 29 No 1, Jan 93 pp 112-114

[Article by S.N. Boyko, Yu.N. Makogon, M.M. Nishchenko, A.I. Ostapchuk, S.I. Sidorenko, I.M. Stepanov, Kiev Polytechnic Institute; UDC 535.338.43:533.59]

[Abstract] An increasing scale of integration in modern chips and the attendant requirements imposed on thin films are discussed, and the effect of various annealing conditions in the air (by millisecond-long pulses of a CW laser in the air) on the phase composition formation of thin film structures formed by a transition metal (Mo, Cr, Ta, Ti, V, Zr, and Re) with silicon is examined. The films are produced by three methods: electron beam vaporization (ELI), magnetron target sputtering (MRM), and thermionic deposition (TIM). The specific film deposition conditions are outlined. B-doped IA3Ts-10/2.5 grade silicon with a <111> orientation is used as the substrate. The effect of laser irradiation in the free lasing mode on the solid phase reactions of silicide phase formation in the metal/Si system is summarized. The study shows that the phase composition and crystal structure of the resulting silicide films depend on the irradiation energy. As the irradiation energy density increases from 0.4 to 90 J/cm^2, the amount of end product, i.e., metal disilicide, increases while the number of intermediate silicide phases decreases. Tables 1; references 9: 1 Russian, 8 Western.

New $CuCr_{1.5}Sb_{0.5}S_4$ Antiferromagnetic Semiconductor

937D0094G Moscow NEORGANICHESKIYE MATERIALY in Russian Vol 29 No 1, Jan 93 pp 115-116

[Article by Ya.A. Kesler, L.I. Koroleva, M.G. Mikheyev, A.G. Odintsov, D.S. Filimonov, Moscow State University imeni M.V. Lomonosov; UDC 546.863'763'221]

[Abstract] A Zn-free analogue of the recently discovered florensovite mineral synthesized for the first time is described. Powdered samples are produced by solid phase synthesis from a stoichiometric mixture of elementary substances by annealing in evacuated ampoules at 820K for 48 h; an X-ray phase analysis is conducted in Co*K* radiation in a DRON-0.5 diffractometer. No superstructural reflections corresponding to a 1:3-type ordering in spinel octahedrons are detected. The electric and magnetic properties of the compound are examined. The temperature dependence of the electric resistivity and reciprocal paramagnetic susceptibility, the dependence of magnetization on the magnetic field strength at 4.2K, and the temperature dependence of the specific susceptibility at low temperatures are plotted. The magnetization is measured by the ballistic method while the temperature dependence of susceptibility in a static field within a 4.2-165K range is measure by a model 155 PARC vibration magnetometer (U.S. made). The new chalocogenide compound has a linear dependence of magnetization, has the structure of spinel, and is an antiferromagnetic semiconductor. Figures 2; references 2.

Investigation of Process for Plasma Surface Hardening of AT3 Alloy

937D0082D Moscow SVAROCHNOYE PROIZVODSTVO in Russian No 11, Nov 92 pp 17-18

[Article by A. V. Petukhov, S. G. Dontsova, and Ye. P. Nikolayeva, Irkutsk Polytechnical Institute; UDC 621.791.7]

[Abstract] Results of surface hardening of AT3 titanium alloy by treatment with a nitrogen plasma jet were determined. Before the treatment, specimens were annealed in a vacuum at 1000° C for three hours to eliminate the influence of hydrogen contained in the titanium alloy. Treatment with nitrogen plasma was conducted without melting the treated surfaces. The specimens were analyzed for the structure of treated zones, their microhardness, nitrogen content, distribution of alloying elements in cross-section, residual microstresses, and corrosion and wear resistance.

It was determined that the nitrogen plasma treatment produces a hardened layer with a surface nitride zone. Treatment conditions which increase crack resistance were determined; this effect is due to the formation of compressive stresses in the hardened layer and destruction of brittle compounds along boundaries of the α-phase. Tribotechnical tests showed that the hardened layers possess high resistance to wear. Also, their resistance to industrial corrosive agents is substantially higher than in the untreated alloy. The method is recommended for treating the heat-affected zone in welded titanium alloys to lower the metal's brittleness in this zone and to increase its corrosion resistance.

Hydrogen's Role in Plasma Surface Hardening

937D0082E Moscow SVAROCHNOYE PROIZVODSTVO in Russian No 11, Nov 92 pp 19-20

[Article by A. Ye. Balanovskiy and N. A. Nesterenko, Irkutsk Polytechnical Institute; UDC 621.791.7]

[Abstract] To understand the role of hydrogen as one of the factors causing brittle failure in plasma surface-hardened parts, experiments were conducted to determine the content of diffusion-mobile hydrogen in the hardened layer when different methods of plasma hardening are used. It was found that the hydrogen content in the hardened layer depends on the brand of steel and the hardening method. The maximum hydrogen content was recorded in the method of plasma hardening in liquid media. The amount of diffusion-mobile hydrogen in this method was determined using alcohol eudiometers, and the amount of residual hydrogen was determined by the method of vacuum extraction at 600° C. Experiments showed that in plasma hardening in liquid media, the following process parameters affect the hydrogen content: the power of the plasma jet, the diameter of the plasma generator's nozzle, the rate of treatment, the amount of plasma-generating gas used, and the thickness of the liquid layer.

Structural Heterogeneity of Welded Zr-2.5 percent Nb Alloy

937D0081A Kiev AVTOMATICHESKAYA SVARKA in Russian No 6, Jun 92 pp 13-14

[Article by G. M. Grigorenko, Doctor of the Technical Sciences, A. V. Tayanovskaya, and L. M. Tkachenko, engineers; Institute of Electric Welding imeni Ye. O. Paton of the Ukrainian Academy of Sciences; UDC 621.791.754'291.053:669.293.5'296:620.18]: 620.193.2.001.5]

[Abstract] A JEM transmission electron microscope was used to examine the fine structure of the weld metal in welds made of Zr-2.5 percent Nb. Plates with a thickness of 2 mm were helium-arc welded at speeds of 10 and 60 m/h. The specimens were studied before and after quenching and vacuum annealing for 2 h at 1000, 780, and 580° C (the specimens were allowed to cool along with the furnace). Foils prepared from the specimens were electropolished on a PTF-3 polishing machine using a reagent consisting of nine parts methanol and one part $HClO_4$ prechilled to -30° C. During polishing, it had a temperature between -8 and -10° C. It was found that welding induces the formation of quenched martensitic structures and partially self-tempered martensite zones in both the weld metal and the HAZ. Annealing at 580° C evidently activates diffusion processes, while annealing at 780° C induces even more intensive aging processes in the weld metal and HAZ. Annealing at 1000° C (β-region) brings out a coarser structure as a result of recrystallization. Water-quenching from 1000° C leads to complete recrystallization and the elimination of chemical heterogeneity. Rapid quenching inhibits the diffusion processes, thus causing a significant portion of impurities to become trapped in the α'-zirconium-based solid solution. Due to the precipitation of an additional β-niobium-type phase, the finely dispersed rounded particles of which settle along the grain boundaries in the near-boundary regions, the resistance of Zr-2.5 percent Nb alloy to corrosion by fluids containing methyl alcohol substantially increases after high-temperature annealing in the β-region. Figures 5; references 4: Russian.

Effect of Surface Plastic Deformation on the Structure of Welded Engineering Titanium

937D0081B Kiev AVTOMATICHESKAYA SVARKA in Russian No 6, Jun 92 pp 15-17

[Article by I. B. Lavrovskaya, engineer, V. P. Prilutskiy, Candidate of the Technical Sciences, S. V. Lapchenko, engineer, and A. D. Shevelev, Candidate of the Technical Sciences; Institute of Electric Welding imeni Ye. O. Paton of the Ukrainian Academy of Sciences; UDC 621.791.7.052:669.295]:620.18]

[Abstract] Argon-arc and electron-beam welds were studied to determine how their structure is affected by surface plastic deformation and subsequent recrystallization annealing. The study was carried out on VT1-00 titanium bars 50 mm in diameter with an average grain size of 0.25 mm. The argon-arc welds were made with a narrow gap filled with VT1-00 welding rod 4 mm in diameter. The electron-beam welds were made without using filler metal. The weld specimens were surface rolled and then vacuum annealed for two hours at 650, 750, 850, and 950° C. The effect of rolling and annealing was evaluated from the average size of the new grains formed in the specimens during recrystallization. Recrystallization intensity was determined from the average size of the recrystallized grains and their distance from the surface of the specimen. It was found that the most desirable grain structure was obtained when the degree of surface plastic deformation was 40 percent and annealing was carried out at 750° C. At this temperature, grain size in the weld metal and HAZ of the argon-arc welds was reduced to 0.05 mm, with the recrystallized grains being as far as 4.5 mm from the specimen surface. In the weld metal and HAZ of the electron-beam welds, grain size was reduced to 0.12 mm at a depth of up to 3.5 mm. The desired grain sizes and depth of recrystallization were insufficient at the other annealing temperatures. Figures 4; references 5: Russian.

The Feasibility of Using Explosion Welding To Produce Double-Clad Zirconium-09G2S Bimetals

937D0081C Kiev AVTOMATICHESKAYA SVARKA in Russian No 6, Jun 92 pp 20-21

[Article by O. A. Denyachenko, Candidate of the Technical Sciences, and Ye. N. Safonova and S. P. Timchenko, engineers; Northern Donetsk Affiliate of the Ukrainian Scientific Research Institute of Chemical Machinery; UDC 621.791.76:621.7.044.2]

[Abstract] The possibility of using explosion welding to make double-clad bimetals was investigated. The specimens were made from E110 zirconium alloy (1 percent niobium) and 09G2S carbon steel. Cladding was applied in two layers, one 3 mm thick and one 4 mm thick. In order to avoid cracking in the first layer during application of the second layer of cladding, the specimens were annealed at 650° C for two hours after applying the first layer of cladding. A standard technique was used to test the tear-apart strength of both annealed and unannealed specimens. It was shown that explosion welding can be used to make double-clad zirconium/steel bimetals; however, the tear-away strength of the annealed bimetal specimens was about 20 percent lower than that of the unannealed specimens. In all cases, failure occurred along the boundary between the steel and the zirconium alloy. Figures 4, references 3: Russian.

A Controllable Focusing Optical Laser Welder

937D0081D Kiev AVTOMATICHESKAYA·SVARKA in Russian No 6, Jun 92 pp 47-49

[Article by N. V. Shestakov, engineer, O. I. Shanin, Doctor of the Technical Sciences, Yu. I. Shanin, Candidate of the Technical Sciences, Luch Scientific Research Institute Production Association, Podolsk, Moscow oblast, A. N. Grezev, Candidate of the Technical Sciences, and V. L. Lukyanenko, engineer, Russian Academy of Sciences Laser Technology Center; UDC 621.791.72.03:621.373.826]

[Abstract] A laser welder with an electronically controllable focusing optical projection system has been developed. The system consists of a standard Kassegren focusing object lens for a TL-5M laser, an off-the-shelf KTP-67 television camera with a Helios-44 lens, two lamps placed near the focusing glass to illuminate the work area, a screen to protect the mosaic of the camera from overexposure, a positionable mirror, a drive system, and an electronic control unit. The camera, which is bracket-mounted, can be moved vertically or within two preset angles. The drive system consists of a DBM-63 motor and a worm drive mechanism that converts the rotary motion of the engine shaft, the end of which is fitted with a rigidly attached nut, into the forward motion of the push screw, one end of which is rigidly fastened to the optical system. The electronic control unit consists of an image pre-processor, a microprocessor, a controller for the drive system, and a power supply, all of which are housed in a metal cabinet connected by a cable to the camera, drive system, lighting system, and monitor. The electronic unit can directly measure the coordinates of the center line of a section of tubing as it is being welded, calculate any deviations of this center line from the axis of the rolling mill from which the welder is suspended, and enable the welder to make the necessary adjustments. The system can thus automatically guide a laser beam down the center line of a section of tubing that is being welded without deviating by more than +/- 50 mm. The new welder is capable of seam welding 25 m of pipe with the requisite weld quality per minute. Figures 4; references 3: Russian.

Features of Welding Aluminum-Lithium Alloys

937D0082A Moscow SVAROCHNOYE PROIZVODSTVO in Russian No 11, Nov 92 pp 3-6

[Article by V. I. Lukin and Yu. P. Arbuzov, All-Union Institute of Aviation Materials; UDC 621.791:629.78]

[Abstract] Features of welding aluminum-lithium alloys for aerospace technology are discussed. Techniques and materials are suggested for overcoming three main difficulties: the tendency for pores to form in welds of these alloys, their low resistance to crack formation in the melting zone, and the ductility of welds being dependent on welding conditions and the quality of the metal of pieces being welded. The problem of pores in welds can be dealt with by removing the surface layer of pieces to be welded, which becomes saturated with hydrogen during heats of these products at the metal plant, by machining or chemical milling, or by heat treatment of the pieces in a vacuum. The problem of crack formation can be alleviated by automated welding using a filler wire alloyed with scandium. A post-welding heat treatment technique is recommended which makes the weld 90-100 percent as strong as the primary metal and which eliminates the problem of post-welding deformation.

Investigation of Structure and Properties of Explosion-Welded Titanium, Zirconium, Niobium and Copper Compounds With Steels, Alloys, and Nonferrous Metals

937D0082B Moscow SVAROCHNOYE PROIZVODSTVO in Russian No 11, Nov 92 pp 10-12

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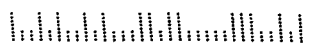
[Abstract] Advantages of a number of explosion-welded bimetals used in various industries are surveyed. For bimetals consisting of titanium compounds with corrosion-resistant steel and chromium-nickel alloy, results of studies of their strength and anti-corrosion properties and metallographic analysis of them are presented. Performance characteristics of thin-wall adapters made of titanium and corrosion-resistant steel for high-pressure lines of aircraft air-conditioning systems are presented. Performance characteristics also are presented for the following bimetal products: zirconium compounds with corrosion-resistant steel and chromium-nickel alloy for adapters used in radiochemical industry and nuclear energy; and aluminum and steel adapters for cryogenic vacuum equipment.

Also described are results with the following explosion-welded trimetals to achieve particular performance properties: niobium-copper-steel, and copper-titanium-aluminum. Finally, development of four types of nonmagnetic bimetals based on beryllium bronze, corrosion-resistant steel, chromium-nickel alloy and aluminum is reported; bimetals of bronze-titanium and bronze-chromium-nickel alloy have been recommended for use as the contactor element in the SA-449 electron-beam welding unit.



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